

CLAIMS:

1. A method of progressive hydro-forming of a tubular member, said method comprising the steps of:

providing a tubular member;

positioning the tubular member between open die halves mating with one another to define a first tubular cavity portion in a first stage;

progressively closing the die halves to progressively deform the tubular member within the first tubular cavity portion;

applying hydraulic pressure to expand and conform the tubular member to the first tubular cavity portion in the first stage;

separating the die halves;

removing the expanded tubular member from the first tubular cavity portion;

positioning the expanded tubular member between open die halves mating with one another to define a second tubular cavity portion in a second stage;

progressively closing the die halves to progressively deform the expanded tubular member within the second tubular cavity portion;

applying hydraulic pressure to expand and conform the expanded tubular member to the second tubular cavity portion in the second stage;

separating the die halves; and

removing the final expanded tubular member from the second tubular cavity portion.

2. A method as set forth in claim 1 including the step of bending the tubular member to a predetermined position prior to said step of positioning in the first stage.

3. A method as set forth in claim 1 wherein said step of providing a tubular member comprises providing a tubular member having a generally circular cross-sectional shape.

4. A method as set forth in claim 1 wherein said step of applying comprises expanding at least one portion of the tubular member by fluid pressure.

5. A method as set forth in claim 1 wherein said step of applying includes the step of expanding at least one portion of the tubular member to have a size greater than a diameter of a remainder of the tubular member.

6. A method as set forth in claim 1 wherein said step of applying includes the step of expanding at least one portion of the tubular member to have a cross-sectional shape different from a cross-sectional shape of a remainder of the tubular member.

7. A method as set forth in claim 6 wherein the cross-sectional shape of the at least one portion is one of circular or oval.

8. A method as set forth in claim 1 wherein said step of applying comprises expanding at least one portion of the expanded tubular member by fluid pressure.

9. A method as set forth in claim 1 wherein said step of applying includes the step of expanding at least one portion of the expanded tubular member to have a size greater than a diameter of a remainder of the expanded tubular member.

10. A method as set forth in claim 1 wherein said step of applying includes the step of expanding at least one portion of the expanded tubular member to have a cross-sectional shape different from a cross-

sectional shape of a remainder of the expanded tubular member.

11. A method as set forth in claim 10 wherein the cross-sectional shape of the at least one portion is one of circular or oval.

12. A method as set forth in claim 1 wherein the finished tubular member is integral, unitary, and one-piece.

13. A method as set forth in claim 1 wherein the tubular member is made of a metal material.

14. A method of progressive hydro-forming of a tubular member, said method comprising the steps of:

providing a metal tubular member;

positioning the tubular member between open die halves mating with one another to define a first tubular cavity portion in a first stage;

applying at least nominal internal hydraulic pressure to the tubular member;

progressively closing the die halves to progressively deform the tubular member within the first tubular cavity portion;

increasing the hydraulic pressure to expand and conform the tubular member to the first tubular cavity portion in the first stage;

separating the die halves;

removing the expanded tubular member from the first tubular cavity portion;

positioning the expanded tubular member between open die halves mating with one another to define a second tubular cavity portion in a second stage;

progressively closing the die halves to progressively deform the expanded tubular member within the second tubular cavity portion;

increasing the hydraulic pressure to expand and conform the expanded tubular member to the second tubular cavity portion in the second stage;

separating the die halves; and

removing the final expanded tubular member from the second tubular cavity portion.

15. A method as set forth in claim 14 including the step of bending the tubular member to a predetermined position prior to said step of applying.

16. A method as set forth in claim 14 wherein said step of providing a tubular member

comprises providing a tubular member having a generally circular cross-sectional shape.

17. A method as set forth in claim 14 wherein said step of increasing includes the step of expanding at least one portion of the tubular member to have a size greater than a diameter of a remainder of the tubular member.

18. A method as set forth in claim 14 wherein said step of increasing includes the step of expanding at least one portion of the tubular member to have a cross-sectional shape different from a cross-sectional shape of a remainder of the tubular member.

19. A method as set forth in claim 18 wherein the cross-sectional shape of the at least one portion is one of circular or oval.

20. A method as set forth in claim 14 wherein said step of increasing includes the step of expanding at least one portion of the expanded tubular member to have a size greater than a diameter of a remainder of the expanded tubular member.

21. A method as set forth in claim 14 wherein said step of increasing includes the step of expanding at least one portion of the expanded tubular member to have a cross-sectional shape different from a cross-sectional shape of a remainder of the expanded tubular member.

22. A method as set forth in claim 21 wherein the cross-sectional shape of the at least one portion is one of circular or oval.

23. A method as set forth in claim 14 wherein the finished tubular member is integral, unitary, and one-piece.

24. A method of progressive hydro-forming of a tubular member, said method comprising the steps of:

providing a metal tubular member;

bending the tubular member to a predetermined position to form a pre-formed tubular member;

positioning the pre-formed tubular member between open die halves mating with one another to define a first tubular cavity portion in a first stage;

applying at least nominal internal hydraulic pressure to the pre-formed tubular member;

progressively closing the die halves to progressively deform the pre-formed tubular member within the first tubular cavity portion;

increasing the hydraulic pressure to expand and conform the pre-formed tubular member to the first tubular cavity portion in the first stage;

separating the die halves;

removing the expanded tubular member from the first tubular cavity portion;

positioning the expanded tubular member between open die halves mating with one another to define a second tubular cavity portion in a second stage;

progressively closing the die halves to progressively deform the expanded tubular member within the second tubular cavity portion;

increasing the hydraulic pressure to expand and conform the expanded tubular member to the second tubular cavity portion in the second stage;

separating the die halves; and

removing the final expanded tubular member from the second tubular cavity portion.